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<b>(54) Title:</b> CONCENTRATED ACETAMINOPHEN SOLUTION COMPOSITIONS  <b>(57) Abstract</b>  Improved concentrated liquid pharmaceutical compositions containing acetaminophen wherein said acetaminophen is formed by adding a Beckman rearrangement catalyst to 4-hydroxyacetophenone oxime.		

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## CONCENTRATED ACETAMINOPHEN SOLUTION COMPOSITIONS

### TECHNICAL FIELD

The present invention relates to improved concentrated liquid pharmaceutical compositions containing acetaminophen as well as a process for their manufacture.

### BACKGROUND OF THE INVENTION

Liquid, and especially concentrated liquid pharmaceutical compositions containing acetaminophen in solution offer several advantages over solid compositions. Liquids are easy to swallow and provide an excellent vehicle for the uniform delivery of pharmaceutical actives. Moreover, liquids provide a rapid onset of pharmacologic action, since the composition does not first have to disintegrate and dissolve in the gastrointestinal tract. Likewise, concentrated liquid compositions offer certain distinct advantages. These compositions are ideally suited for incorporation into easy-to-swallow soft, flexible capsules. Encapsulation of this nature permits the accurate and uniform delivery of unit dose amounts of a pharmaceutical active, encompassing even those instances where relatively small amounts of a pharmaceutical active are to be delivered. In addition, soft gelatin capsules are aesthetically appealing (especially when filled with a transparent liquid) and can be manufactured in a wide variety of sizes, shapes, and colors.

These advantages notwithstanding, it is often difficult to prepare such compositions using the desired pharmaceutical active however. Acetaminophen is poorly soluble and, therefore, require relatively large volumes of solvent for dissolution, resulting in impractically large doses. Also, encapsulating such large volumes into easy-to-swallow gelatin capsules presents obvious difficulties, suggesting the immediate importance of concentrated liquid compositions. Furthermore, the situation becomes even more complicated when multiple pharmaceutical actives are involved.

The most frequently used approach to this solubility problem is to force solubility into small volumes of solvent by means of a step-wise process incorporating heat. This step-wise process consists of dissolving the acetaminophen in polyethylene glycol and polyvinylpyrrolidone with heat, followed by the addition of any additional pharmaceutical actives. Because the resultant concentrated liquid (or fill) is a supersaturated solution of the acetaminophen, it is even more difficult to increase the resultant composition's concentration of acetaminophen.

The present inventor has discovered that by using a specific acetaminophen formed by adding a Beckman rearrangement catalyst to 4-hydroxyacetophenone oxime, said catalyst having an electrophilic carbon atom at which said catalyst reacts with said oxime provides compositions having improved stability.

It is, therefore, an object of the present invention to provide such compositions containing acetaminophen having improved stability. A further object of the present invention is to enhance stability of the resultant composition by reducing the tendency of the acetaminophen to precipitate out of solution. These and other  
5 objects of this invention will become apparent in light of the following discussion.

### SUMMARY OF THE INVENTION

The present invention relates to concentrated liquid pharmaceutical composition comprising:

- 10 (a) from about 1% to about 50% of acetaminophen formed by adding a Beckman rearrangement catalyst to 4-hydroxyacetophenone oxime, said catalyst having an electrophilic carbon atom at which said catalyst reacts with said oxime;
- (b) from about 20% to about 70% of a polyethylene glycol;
- (c) from about 1% to about 30% of a polyvinylpyrrolidine;
- 15 (d) from about 1% to about 10% of a propylene glycol and wherein the ratio of said polyethylene glycol to said polyvinylpyrrolidone is at least about 2.5:1.

The compositions preferably further comprises from about 0.5% to about 20% of at least one additional pharmaceutical active in from about 1% to about 50% of an  
20 aqueous phase.

All percentages and ratios used herein are by weight and all measurements are at 25°C, unless otherwise indicated.

### DETAILED DESCRIPTION OF THE INVENTION

The highly concentrated liquid pharmaceutical compositions of the present invention comprise the following essential, as well as optional, components.  
25

#### Acetaminophen

The acetaminophen used in the compositions of the present invention is formed as follows. Acetaminophen (N-acetyl-para-aminophenol) is formed by reacting 4-hydroxyacetophenone (4-HAP) with hydroxylamine to form the ketoxime to a Beckman rearrangement in the presence of an alkyl alkanoate ester solvent and an appropriate acidic catalyst to form the N-acyl-hydroxyaromatic amine.  
30

4-Hydroxyacetophenone used to form the oxime may be prepared by any method known in the art.

The conversion of 4-HAP into the ketoxime is accomplished by contacting the  
35 ketone with a hydroxylamine salt, e.g., hydroxylamine hydrochloride, hydroxylamine sulfate, hydroxylamine bisulfate, or hydroxylamine phosphate, and a base, e.g.

ammonium hydroxide (aqueous ammonia), potassium hydroxide, sodium hydroxide, or lithium hydroxide.

The base should be used in an amount, for example, of 0.5 to 2 molar equivalents per molar equivalent of starting hydroxylamine. Oximation is run at a temperature, for example, of 0° to 200°C, for a period of from about 5 minutes to 4 hours. Any pressure may be used, e.g., 80 mm of mercury to 20 atmospheres absolute. The reaction is preferably carried out in an aqueous or alcoholic medium, i.e., in the presence of water and/or an alcohol such as methanol, ethanol, or isopropanol.

The 4-HAP oxime is converted into APAP by a Beckmann rearrangement by contacting the ketoxime with an alkyl alkanoate ester solvent and an appropriate acidic catalyst at a reaction temperature, for example, of from 0° to 100°C for a period of from about 5 minutes to 4 hours. The weight ratio of oxime to Beckmann rearrangement catalyst ranges from about 5:1 to about 300:1.

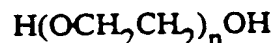
The Beckmann reaction is carried out to 4-HAP oxime conversions of preferably at least about 50% and more preferably at least about 80% to minimize losses of unreacted 4-HAP oxime to recrystallization and wash liquors. Conversions of 4-HAP oxime during Beckmann rearrangements can be controlled by use of an appropriate quantity of catalyst.

The process of this invention is preferably carried out by adding an alkali metal iodide such as potassium iodide to the 4-hydroxyacetophenone oxime prior to carrying out the Beckmann rearrangement in alkyl alkanoate ester solvent.

Appropriate acidic catalysts for use in the Beckmann rearrangement of 4-hydroxyacetophenone oxime to APAP include, but are not limited to, thionyl chloride; methanesulfonyl chloride; trifluoromethanesulfonyl chloride; methanesulfonic anhydride; the mixed anhydride of trichloroacetic and methanesulfonic acids; p-toluenesulfonic anhydride; phosphorus oxytrichloride; phosphorus pentoxide; phenylphosphonic dichloride; diphenylphosphinic chloride; trifluoroacetic anhydride; trichloroacetic anhydride; trifluoroacetyl chloride; trichloroacetyl chloride; oxaly chloride; ethyl oxalyl chloride; phosgene; trichloromethyl chloroformate (diphosgene); methyl chloroformate; N,N-dimethylcarbonyl chloride; nitrilium salts; and any Vilsmeier reagent prepared from a carboxylic amide. The process is more fully detailed in U.S. Patent 5,155,273 to Fritch et al., issued October 13, 1992 which is herein incorporated by reference. Acetaminophen manufactured via this process is available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation, Somerville, NJ.

### Polyethylene Glycol

An essential component of the present compositions is a polyethylene glycol. Polyethylene glycols generally are clear, viscous liquids or white solids which are soluble in water and many organic solvents. These polymers correspond to the  
5 general formula:



where n is greater than or equal to 4. Polyethylene glycols are described in G.M. Powell, III in Handbook of Water-Soluble Gums & Resins, R.L. Davidson, Ed. (McGraw-Hill, New York, 1980) pp. 18/1-18/31, this reference being incorporated  
10 herein by reference in its entirety. Polyethylene glycols, which are also known as "PEGs" or "polyoxyethylenes", are designated by both their average molecular weight range and their average "n" value as in the above designated formula. For example, polyethylene glycol 400, which is also known by the CTFA designation, PEG-8, has an average molecular weight range from 380-420 and an average value  
15 of n between 8.2 and 9.1. See CTFA Cosmetic Ingredient Dictionary, Third Edition (1982), pp. 201-203; and The Merck Index, Tenth Edition, entry 7441, p. 1092 (1983); these two references being incorporated herein by reference in their entirety.

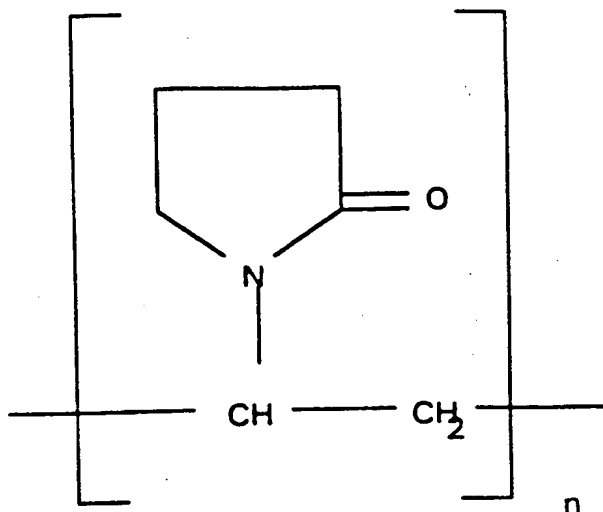
Polyethylene glycols useful herein are mixtures of those which are liquids at room temperature or have a melting point slightly thereabove. Preferred mixtures  
20 include those polyethylene glycols having a molecular weight range of from about 300 to about 1000 and corresponding n values of from about 6 to about 20. More preferred are those of polyethylene glycols having a molecular weight range of from about 400 to about 1000 and corresponding n values of from about 8 to about 20. Most preferred are those of polyethylene glycols having a molecular weight range of  
25 from about 600 to about 1000 and corresponding n values of from about 12 to about 20. Liquid and low-melting polyethylene glycols are commercially available from Union Carbide (Danbury, CT) under the Carbowax® trademark. See "Carbowax® Polyethylene Glycols", Union Carbide Technical Bulletin f-4772M-ICD 11/86-20M, this reference being incorporated herein by reference in its entirety

30 Polyethylene glycols having an average molecular weight below about 300 are not desirable for use in the instant invention since such polyethylene glycols tend to diffuse into, plasticize, and ultimately disrupt the soft gelatin shells which can be employed to encapsulate the compositions described herein.

The process for preparing the highly concentrated liquid compositions of the  
35 present invention comprises adding from about 20% to about 70% polyethylene glycol, more preferably from about 30% to about 60%, and most preferably from about 35% to about 55%.

Polyvinylpyrrolidone

An essential component of the present compositions is polyvinylpyrrolidone ("PVP"), which is a polymer of N-vinyl-2-pyrrolidone having the following formula:



5

Polyvinylpyrrolidones are described in L. Blecher et al. in Handbook of Water-Soluble Gums & Resins, R.L. Davidson, Ed. (McGraw-Hill, New York, 1980) pp. 21/1-21/21, this reference being incorporated herein by reference in its entirety.

10 Polyvinylpyrrolidone has different solubility characteristics based on its polymeric structure. Long-chain polyvinylpyrrolidone, which is also known as povidone, has good solubility in water and a number of organic solvents. Cross-linked polyvinylpyrrolidone, which is also known as crosopovidone, is insoluble in virtually all common solvents. Both the soluble and insoluble forms of polyvinylpyrrolidone are

15 commercially available from GAF Chemicals Company (Wayne, NJ) under the Plasdone® and Polyplasdone® trademarks, respectively, and from BASF Aktiengesellschaft (Ludwigshafen, Germany) under the Kollidon® trademark. Soluble forms of polyvinylpyrrolidone include Plasdone® K-25, Plasdone® K-26/28, Plasdone® K-29/32, Plasdone® C-15, Plasdone® C-30, Plasdone® C-90, Kollidon® 12 PF,

20 Kollidon® 17 PF, Kollidon® 25, Kollidon® 30, and Kollidon® 90. Insoluble forms of polyvinylpyrrolidone include Polyplasdone XL®, Polyplasdone XL®10, Kollidon® CL, and Kollidon® CL-M. See "Tableting With Plasdone®", GAF Technical Bulletin 2302-110R1 (1986); "Polyplasdone XL®, Polyplasdone XL®10", GAF Technical Bulletin 2302-099 R2 (1984); and "Kollidon® Grades, Polyvinylpyrrolidone for the Pharmaceutical Industry", BASF Technical Bulletin MEF 129e,

25 Register 2, May 1986 (Bn); these references being incorporated herein by reference in their entirety.

The soluble forms of polyvinylpyrrolidone are preferred for use in the present invention. Preferred are soluble polyvinyl- pyrrolidones having an viscosity average molecular weight in the range from about 5000 to about 25,000; more preferred are those having an viscosity average molecular weight in the range from about 5000 to about 15,000; and most preferred are those having an viscosity average molecular weight from about 5,000 to about 10,000. Moreover, mixtures of two or more soluble polyvinylpyrrolidones of different average molecular weight can be employed.

The process for preparing the highly concentrated liquid compositions of the instant invention comprises adding from about 1% to about 28% of a soluble polyvinylpyrrolidone, more preferably from about 1% to about 15%, and most preferably from about 2% to about 10%.

Preferably, the ratio of the total amount of polyethylene glycol to polyvinylpyrrolidone should be at least about 2.5:1.

#### Propylene Glycol

Propylene glycol, which is represented by the formula:



is well known in the art for its solvent and/or humectant properties. A colorless and viscous liquid, propylene glycol is miscible with water, alcohols and many organic solvents. Propylene glycol is described in Hawley's Condensed Chemical Dictionary, pp. 970-971, (Revised by Richard J. Lewis, Sr.) (12th ed. 1993, herein incorporated by reference. Propylene glycol suitable for use in the present invention is obtainable from any number of suppliers, Dow Chemical being one.

#### Additional Pharmaceutical Actives

The compositions of the instant invention can optionally contain one or more additional pharmaceutical actives. Useful classes of pharmaceutically-active compounds which can be incorporated into the present compositions include analgesics (other than acetaminophen), anti-inflammatory agents, anti-pyretics, calcium channel blockers, beta-blockers, antibacterials, antidepressants, antidiabetics, anti-emetics, antihistamines, cerebral stimulants, sedatives, anti-parasitics, expectorants, diuretics, decongestants, antitussives, muscle relaxants, anti-Parkinsonian agents, bronchodilators, cardiotonics, antibiotics, antivirals, nutritional supplements (such as vitamins, minerals, fatty acids, amino acids, and the like), and mixtures thereof.

Specific examples of these additional pharmaceutical actives useful in the present invention include, but are not limited to, acetylsalicylic acid, ibuprofen, fenbuprofen, fenoprofen, flurbiprofen, indomethacin, ketoprofen, naproxen, their pharmaceutically-acceptable salts, and mixtures thereof; pseudoephedrine and its salts such as pseudoephedrine hydrochloride; dextromethorphan and its salts such as



dextromethorphan hydrobromide; doxylamine and its salts such as doxylamine succinate; phenindamine and its salts such as phenindamine hydrogen tartrate; pheniramine and its salts such as pheniramine maleate; chlorpheniramine and its salts such as chlorpheniramine maleate; ephedrine and its salts such as ephedrine sulfate; 5 triprolidine and its salts such as triprolidine hydrochloride; diphenhydramine and its salts such as diphenhydramine hydrochloride, diphenhydramine citrate, and diphenhydramine 8-chlorotheophyllinate; phenyltoloxamine and its salts; guaifenesin; phenylpropanolamine hydrochloride; and mixtures thereof. Preferred additional pharmaceutical actives are dextromethorphan hydrobromide, doxylamine succinate, 10 pseudoephedrine hydrochloride, chlorpheniramine maleate, guaifenesin, triprolidine hydrochloride, diphenhydramine hydrochloride and mixtures thereof.

A further class of optional actives include those useful in promoting or maintaining healthy skin. Examples of such actives are disclosed in U.S. Patent 5,073,371, to Turner et al., issued December 17, 1991, this patent being incorporated herein by reference in its entirety. 15

The process for preparing the highly concentrated liquid compositions of the instant invention comprises adding one or more of these optionally additional pharmaceutical actives at a concentration of from about 0.5% to about 20%.

#### Coolants

20 In addition, the present invention may optionally incorporate a cooling agent or a combination of cooling agents. Suitable cooling agents are those described in U.S. Patent 4,136,163, January 23, 1979, to Watson et al., U.S. Patent 4,230,668, October 28, 1980, to Rowsell et al. and U.S. Patent 4,032,661, to Rowsell et al., all of which are herein incorporated by reference. A particularly preferred cooling agent is N-ethyl-p-menthane-3-carboxamide (WS-3 supplied by Sterling Organics), 25 taught by the above incorporated U.S. Patent 4,136,163. Another particularly preferred cooling agent is 3-1-menthoxypropane 1,2-diol (TK-10 supplied by Takasago Perfumery Co., Ltd., Tokyo, Japan). This material is described in detail in U.S. Patent 4,459,425, July 10, 1984 to Amano et al. and incorporated herein by reference. 30

#### Other Optional Components

Optional components which can be incorporated into the compositions of the instant invention include coolants, colorings, flavorings, preservatives, lubricants, flow-enhancers, filling aids, anti-oxidants, essences, and other aesthetically pleasing 35 components.

### Process for Solubilizing the Acetaminophen

The highly concentrated liquid pharmaceutical compositions are prepared using art-recognized principles and methodologies in mixing the ingredients together and in choosing the type of mixing equipment to be used. In a preferred manner of execution, the acetaminophen, polyethylene glycol, propylene glycol and polyvinylpyrrolidone, are combined in the presence of heat and mixed until dissolved to form a homogeneous solution. Upon dissolution of the acetaminophen, additional pharmaceutical actives may then be added to this batch solution or dissolved separately in an aqueous phase. The process is completed once all additional pharmaceutical actives have been added, whether by direct addition to the original batch solution and/or by indirectly transferring the separately formed admixture to the original batch.

### Soft Gelatin Capsules

Preselected amounts of the highly concentrated liquid pharmaceutical compositions of the present invention can also be encapsulated in a soft gelatin shell. Optionally, the soft gelatin shell is essentially transparent so as to enhance the aesthetic qualities of the capsule. The soft gelatin shells comprise the following essential, as well as optional, components.

### Gelatin

Gelatin is an essential component of the soft gelatin shells of the instant invention. The starting gelatin material used in the manufacture of soft capsules is obtained by the partial hydrolysis of collagenous material, such as the skin, white connective tissues, or bones of animals. Gelatin material can be classified as Type A gelatin, which is obtained from the acid-processing of porcine skins and exhibits an isoelectric point between pH 7 and pH 9; and Type B gelatin, which is obtained from the alkaline-processing of bone and animal (bovine) skins and exhibits an isoelectric point between pH 4.7 and pH 5.2. Blends of Type A and Type B gelatins can be used to obtain a gelatin with the requisite viscosity and bloom strength characteristics for capsule manufacture. Gelatin suitable for capsule manufacture is commercially available from the Sigma Chemical Company, St. Louis, Mo. For a general description of gelatin and gelatin-based capsules, see Remington's Pharmaceutical Sciences, 16th ed., Mack Publishing Company, Easton, Pa. (1980), page 1245 and pages 1576-1582; and U.S. Patent 4,935,243, to Borkan et al., issued June 19, 1990; these two references being incorporated herein by reference in their entirety.

The soft gelatin shell of the capsules of the instant invention, as initially prepared, comprises from about 20% to about 60% gelatin, more preferably from about 25% to about 50% gelatin, and most preferably from about 40% to about 50%

gelatin. The gelatin can be of Type A, Type B, or a mixture thereof with bloom numbers ranging from about 60 to about 300.

#### Plasticizer

5 A plasticizer is another essential component of the soft gelatin shells of the instant invention. One or more plasticizers is incorporated to produce a soft gelatin shell. The soft gelatin thus obtained has the required flexibility characteristics for use as an encapsulation agent. Useful plasticizers of the present invention include glycerin, sorbitan, sorbitol, or similar low molecular weight polyols, and mixtures thereof.

10 The shell of the present invention, as initially prepared, comprises from about 10% to about 35% plasticizer, preferably from about 10% to about 25% plasticizer, and most preferably from about 10% to about 20% plasticizer. A preferred plasticizer useful in the present invention is glycerin.

#### Water

15 The soft gelatin shells of the instant invention also comprise water as an essential component. Without being limited by theory, the water is believed to aid in the rapid dissolution or rupture of the soft gelatin shell upon contact with the gastrointestinal fluids encountered in the body.

20 The shell of the present invention, as initially prepared, comprises from about 15% to about 50% water, more preferably from about 25% to about 40% water, and most preferably from about 30% to about 40% water.

#### Other Optional Components

25 Other optional components which can be incorporated into the soft gelatin shells include colorings, flavorings, preservatives, anti-oxidants, essences, and other aesthetically pleasing components.

#### Soft Gelatin Shell Preparation and Encapsulation

30 The solubilized pharmaceutical compositions of the present invention can be encapsulated within any conventional soft gelatin shell that is capable of substantially containing the composition for a reasonable period of time. The soft gelatin shells of the instant invention can be prepared by combining appropriate amounts of gelatin, water, plasticizer, and any optional components in a suitable vessel and agitating and/or stirring while heating to about 65°C until a uniform solution is obtained. This soft gelatin shell preparation can then be used for encapsulating the desired quantity of the solubilized fill composition employing standard encapsulation methodology to  
35 produce one-piece, hermetically-sealed, soft gelatin capsules. The gelatin capsules are formed into the desired shape and size so that they can be readily swallowed. The soft gelatin capsules of the instant invention are of a suitable size for easy

swallowing and typically contain from about 100 mg to about 2000 mg of the solubilized pharmaceutical active composition. Soft gelatin capsules and encapsulation methods are described in P.K. Wilkinson et al., "Softgels: Manufacturing Considerations", Drugs and the Pharmaceutical Sciences, 41 (Specialized Drug Delivery Systems), P. Tyle, Ed. (Marcel Dekker, Inc., New York, 1990) pp.409-449; F.S. Hom et al., "Capsules, Soft", Encyclopedia of Pharmaceutical Technology, vol. 2, J. Swarbrick and J.C. Boylan, eds. (Marcel Dekker, Inc., New York, 1990) pp. 269-284; M.S. Patel et al., "Advances in Softgel Formulation Technology", Manufacturing Chemist, vol. 60, no. 7, pp. 26-28 (July 1989); M.S. Patel et al., "Softgel Technology", Manufacturing Chemist, vol. 60, no. 8, pp. 47-49 (August 1989); R.F. Jimerson, "Softgel (Soft Gelatin Capsule) Update", Drug Development and Industrial Pharmacy (Interphex '86 Conference), vol. 12, no. 8 & 9, pp. 1133-1144 (1986); and W.R. Ebert, "Soft Elastic Gelatin Capsules: A Unique Dosage Form", Pharmaceutical Technology, vol. 1, no. 5, pp. 44-50 (1977); these references are incorporated by reference herein in their entirety. Methods for tempering soft gelatin capsules are described in U.S. Patent 5,200,191 to Steele et al., herein incorporated by reference. The resulting soft gelatin capsule is soluble in water and in gastrointestinal fluids. Upon swallowing the capsule, the gelatin shell rapidly dissolves or ruptures in the gastrointestinal tract thereby introducing the pharmaceutical actives into the physiological system.

### EXAMPLES

The following examples further describe and demonstrate embodiments within the scope of the present invention. The examples are given solely for the purpose of illustration and are not to be construed as limitations of the present invention, as many variations thereof are possible without departing from the spirit and scope of the invention.

#### EXAMPLE I

##### Solubilized Pharmaceutical Composition

A highly concentrated solution containing acetaminophen in combination with other pharmaceutical actives is prepared from the following ingredients:

<u>Ingredients</u>	<u>Weight %</u>
Acetaminophen <sup>1</sup>	31.25
Pseudoephedrine HCl	2.88
Dextromethorphan HBr	1.44
Doxylamine Succinate	0.60
Polyethylene Glycol 600	24.38
Polyethylene Glycol 1000	22.14

Propylene Glycol	4.33
Polyvinylpyrrolidone <sup>2</sup>	8.17
Water Purified	4.81

<sup>1</sup> Available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation

5 <sup>2</sup> Available as Kollidon K-17 PF from BASF Chem.Co. (Viscosity average molecular weight  $\approx$  10,000)

A solution of the polyethylene glycols, propylene glycol, and polyvinylpyrrolidone is prepared by mixing and warming these compositions to 70°C. Acetaminophen is then dissolved into this solution, stirring and heating the solution to 120°C  
10 in the presence of nitrogen. Once the acetaminophen is dissolved the solution is removed from the heat. In a separate container, pseudoephedrine HCl, dextromethorphan HBr and doxylamine succinate are sequentially dissolved in water at room temperature by stirring. Finally, this separate admixture is combined with the original batch solution and mixed until uniform.

15 Examples II-III are further examples of concentrated solutions containing acetaminophen in combination with other pharmaceutical actives and are manufactured in a manner substantially similar to Example I

#### EXAMPLE II

##### Solubilized Pharmaceutical Composition

20	<u>Ingredients</u>	<u>Weight %</u>
	Acetaminophen <sup>1</sup>	31.25
	Pseudoephedrine HCl	2.88
	Dextromethorphan HBr	1.44
	Doxylamine Succinate	0.60
25	Polyethylene Glycol 600	24.38
	Polyethylene Glycol 1000	22.14
	Propylene Glycol	4.33
	Polyvinylpyrrolidone <sup>2</sup>	8.17
	Water Purified	4.81

30 <sup>1</sup> Available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation

<sup>2</sup> Available as Kollidon K-12 PF from BASF Chem.Co. (Viscosity average molecular weight  $\approx$  5,000)

#### EXAMPLE III

##### Solubilized Pharmaceutical Composition

35	<u>Ingredients</u>	<u>Weight %</u>
	Acetaminophen <sup>1</sup>	31.25
	Pseudoephedrine HCl	2.88

	Dextromethorphan HBr	1.44
	Chlorpheniramine Maleate	0.19
	Polyethylene Glycol 600	24.52
	Polyethylene Glycol 1000	22.40
5	Propylene Glycol	4.33
	Polyvinylpyrrolidone <sup>2</sup>	8.17
	Water Purified	4.82

<sup>1</sup> Available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation

<sup>2</sup> Available as Kollidon K-17 PF from BASF Chem.Co. (Viscosity average molecular weight  $\approx$  10,000)

#### EXAMPLE IV

##### Solubilized Pharmaceutical Composition

A highly concentrated solution containing acetaminophen and guaifenesin in combination with other pharmaceutical actives is prepared from the following ingredients:

	<u>Ingredients</u>	<u>Weight %</u>
	Acetaminophen <sup>1</sup>	31.25
	Pseudoephedrine HCl	2.88
	Dextromethorphan HBr	0.96
20	Guaifenesin	9.62
	Polyethylene Glycol 600	21.12
	Polyethylene Glycol 1000	19.26
	Propylene Glycol	2.88
	Polyvinylpyrrolidone <sup>2</sup>	8.17
25	Water Purified	3.86

<sup>1</sup> Available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation

<sup>2</sup> Available as Kollidon K-17 PF from BASF Chem.Co. (Viscosity average molecular weight  $\approx$  10,000)

A solution of polyethylene glycols, propylene glycol, and polyvinylpyrrolidone is prepared by mixing and warming to 70°C. Acetaminophen is then dissolved into this solution, stirring and heating the solution to 120°C in the presence of nitrogen. Once the acetaminophen is dissolved and the solution removed from heat, the guaifenesin is next added and dissolved. In a separate container, pseudoephedrine HCl, dextromethorphan HBr and doxylamine succinate are sequentially dissolved in water at room temperature by stirring. Finally, this separate admixture is combined with the original batch solution and mixed until uniform.

EXAMPLE VSolubilized Pharmaceutical Composition

Example V is a further example of a concentrated solution containing acetaminophen and guaifenesin in combination with other pharmaceutical actives and is manufactured in a manner substantially similar to Example IV.

	<u>Ingredients</u>	<u>Weight %</u>
	Acetaminophen <sup>1</sup>	31.25
	Pseudoephedrine HCl	2.88
	Dextromethorphan HBr	0.96
10	Guaifenesin	9.62
	Polyethylene Glycol 600	21.12
	Polyethylene Glycol 1000	19.26
	Propylene Glycol	2.88
	Polyvinylpyrrolidone <sup>2</sup>	8.17
15	Water Purified	3.86

<sup>1</sup> Available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation

<sup>2</sup> Available as Kollidon K-12 PF from BASF Chem.Co. (Viscosity average molecular weight  $\approx$  5,000).

EXAMPLE VISolubilized Pharmaceutical Composition

A highly concentrated solution containing acetaminophen is prepared from the following ingredients

	<u>Ingredients</u>	<u>Weight %</u>
	Acetaminophen <sup>1</sup>	31.25
25	Polyethylene Glycol 600	26.96
	Polyethylene Glycol 1000	24.48
	Propylene Glycol	4.33
	Polyvinylpyrrolidone <sup>2</sup>	8.17
	Water Purified	4.81

<sup>1</sup> Available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation

<sup>2</sup> Available as Kollidon K-17 PF from BASF Chem.Co. (Viscosity average molecular weight  $\approx$  10,000)

A solution of the polyethylene glycols, propylene glycol, and polyvinylpyrrolidone is prepared by mixing and warming these components to 70°C. Acetaminophen is then dissolved into this solution, stirring and heating the solution to 120°C in the presence of nitrogen gas. Once the acetaminophen is dissolved, the solution is

removed from the heat. Finally, a measured quantity of the aqueous phase is combined with the original batch solution and mixed until uniform.

#### EXAMPLE VII

##### Solubilized Pharmaceutical Composition

5 A highly concentrated solution containing acetaminophen and pseudoephedrine HCl is prepared from the following ingredients

	<u>Ingredients</u>	<u>Weight %</u>
	Acetaminophen <sup>1</sup>	31.25
	Pseudoephedrine HCl	2.88
10	Polyethylene Glycol 600	25.45
	Polyethylene Glycol 1000	23.11
	Propylene Glycol	4.33
	Polyvinylpyrrolidone <sup>2</sup>	8.17
	Water Purified	4.81

15 <sup>1</sup> Available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation

<sup>2</sup> Available as Kollidon K-17 PF from BASF Chem.Co. (Viscosity average molecular weight  $\approx$  10,000)

A solution of the polyethylene glycols, propylene glycol, and polyvinylpyrrolidone is prepared by mixing and warming these components to 70°C. Acetaminophen is then dissolved into this solution, stirring and heating the solution to 120°C in the presence of nitrogen gas. Once the acetaminophen is dissolved, the solution is removed from the heat. In a separate container, pseudoephedrine HCl is dissolved in water at room temperature by stirring. Finally, this separate admixture is combined with the original batch solution and mixed until uniform.

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#### EXAMPLE VIII

##### Solubilized Pharmaceutical Composition

A highly concentrated solution containing acetaminophen in combination with other pharmaceutical actives is prepared from the following ingredients:

	<u>Ingredients</u>	<u>Weight %</u>
30	Acetaminophen <sup>1</sup>	27.17
	Pseudoephedrine HCl	3.26
	Dextromethorphan HBr	1.09
	Doxylamine Succinate	0.68
	Polyethylene Glycol 600	29.76
35	Polyethylene Glycol 1000	27.17
	Propylene Glycol	4.35
	Polyvinylpyrrolidone <sup>2</sup>	2.17



## Water Purified

4.35

<sup>1</sup> Available as Acetaminophen USP/BP powder from Hoechst Celanese Corporation

<sup>2</sup> Available as Kollidon K-30 from BASF Chem.Co. (Viscosity average molecular weight  $\approx$  38,000)

- 5        A solution of the polyethylene glycols, propylene glycol, and polyvinylpyrrolidone is prepared by mixing and warming these components to 70°C. Acetaminophen is then dissolved into this solution, stirring and heating the solution to 120°C in the presence of nitrogen gas. Once the acetaminophen is dissolved, the solution is removed from the heat. In a separate container, pseudoephedrine HCl, dextromethorphan HBr and doxylamine succinate are sequentially dissolved in water at room
- 10        temperature by stirring. Finally, this separate admixture is combined with the original batch solution and mixed until uniform.

EXAMPLE IXSoftgel Capsule Containing a Solubilized Pharmaceutical Composition

- 15        A soft gelatin capsule is first prepared from the following ingredients:

<u>Ingredients</u>	<u>Weight %</u>
Gelatin	47.00
Glycerin	5.00
Water Purified	qs 100

- 20        The above ingredients are combined in a suitable vessel and heated with mixing at about 65°C to form a uniform solution. Using standard encapsulation methodology, the resulting solution is used to prepare soft gelatin capsules containing approximately 1040 mg. of the compositions of Examples I-VII and 920 mg. of the composition of Example VIII. The resulting soft gelatin capsules are suitable for
- 25        oral administration.

WHAT IS CLAIMED IS:

What is Claimed is:

1. A concentrated liquid pharmaceutical composition comprising:
  - (a) from 1% to 50% of acetaminophen wherein said acetaminophen is formed by adding a Beckman rearrangement catalyst to 4-hydroxyacetophenone oxime, said catalyst having an electrophilic carbon atom at which said catalyst reacts with said oxime;
  - (b) from 20% to 70% of a polyethylene glycol;
  - (c) from 1% to 30% of a polyvinylpyrrolidine; and
  - (d) from 1% to 10% of a propylene glycol.
2. A concentrated liquid pharmaceutical composition according to Claim 1 wherein said acetaminophen is formed by adding a Beckman rearrangement catalyst comprising a nitrilium cation, preferably N-methylacetonitrilium cation.
3. A concentrated liquid pharmaceutical composition according to any of the preceding Claims wherein said Beckman rearrangement catalyst further comprises tetrafluoroborate anion and wherein the viscosity average molecular weight of said polyvinylpyrrolidine is from 5,000 to 15,000, preferably from 5,000 to 10,000 and wherein the ratio of said polyethylene glycol to said polyvinylpyrrolidone is at least 2.5:1 and wherein the ratio of polyethylene glycol to said acetaminophen and said polyvinylpyrrolidine is from 1:0.3 to 1:0.9 and from 1:0.09 to 1:0.3 respectively.
4. A concentrated liquid pharmaceutical composition according to any of the preceding Claims wherein said polyethylene glycol is added in an amount from 30% to 65% and preferably in an amount from 40% to 60%.
5. A concentrated liquid pharmaceutical composition according to any of the preceding Claims wherein said polyethylene glycol is selected from a group consisting of PEG-6, PEG-8, PEG-9, PEG-10, PEG-12, PEG-14, PEG-16, PEG-18, PEG-20, and mixtures thereof, preferably said polyethylene glycol is a mixture of PEG-12 and PEG-20 in a ratio of 1:1.
6. A concentrated liquid pharmaceutical composition according to any of the preceding Claims which further comprises from 1% to 50% of an aqueous phase.

7. A concentrated liquid pharmaceutical composition according to any of the preceding Claims wherein one or more additional pharmaceutical actives are added to said aqueous phase and wherein said active is selected from the group of pharmaceutical actives consisting of dextromethorphan, HBr, doxylamine succinate, pseudoephedrine HCl, chlorpheniramine maleate, guaifenesin, triprolidine HCl, diphenhydramine HCl, and mixtures thereof, preferably the additional pharmaceutical actives are doxylamine succinate, dextromethorphan HBr, and pseudoephedrine HCl.

# INTERNATIONAL SEARCH REPORT

Int. Application No  
PCT/US 95/02488

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 6 A61K9/48

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	WO, A, 95 04527 (SCHERER CORP.) 16 February 1995 see the whole document ---	1-7
A	WO, A, 88 02625 (SCHERER CORP.) 21 April 1988 ---	
A	US, A, 5 155 273 (FRITCH ET AL.) 13 October 1992 cited in the application -----	

☐

Further documents are listed in the continuation of box C.

☒

Patent family members are listed in annex.

\* Special categories of cited documents :

- \* "A" document defining the general state of the art which is not considered to be of particular relevance
- \* "E" earlier document but published on or after the international filing date
- \* "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \* "O" document referring to an oral disclosure, use, exhibition or other means
- \* "P" document published prior to the international filing date but later than the priority date claimed

- \* "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \* "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \* "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \* "&" document member of the same patent family

Date of the actual completion of the international search

29 June 1995

Date of mailing of the international search report

14. 07. 95

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+ 31-70) 340-3016

Authorized officer

Klaver, T